To David, whose bookshelves introduced me to the rest of the universe through Asimov, Bradbury and Clarke, and who bought me *that* Bowie record. – GA

For Rusty (the first dingo in space). – CN

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BALLOON to the Moon

Gill Arbuthnott • Christopher Nielsen

B P P

TIMELINE

5th century BC: Kites invented in China

1232: Chinese use gunpowder-powered rockets as weapons

15th–16th centuries: Leonardo da Vinci draws designs for flying machines

15th–16th centuries: Galileo Galilei discovers how to predict the paths of projectiles

17th century: Sir Isaac Newton publishes his Laws of Gravity (1666) and Laws of Motion (1686)

1783: The Montgolfier brothers demonstrate their invention, the hot air balloon

1891: Otto Lilienthal builds and flies his first glider

1877: Internal combustion engine invented

1903: The Wright brothers make the first powered, controlled aircraft flight

1926: Robert H Goddard launches the first liquid-powered rocket

1942: Wernher von Braun develops the V-2 missile

1947: Chuck Yeager breaks the sound barrier in the Bell X-1

1957: Laika the dog becomes the first living creature to orbit Earth

1957: The Soviet Union launches Sputnik1, the first satellite, into orbit

1961: Yuri Gagarin becomes the first human in space and to orbit Earth

1961: Alan Shepard becomes the first American in space

1967: Apollo 1 fire kills three astronauts

1963: Valentina Tereshkova becomes the first woman in space and to orbit Earth

1969: Neil Armstrong, of Apollo 11, becomes the first man to walk on the Moon

1972: Eugene Cernan, of Apollo 17, becomes the last man to walk on the Moon

1973: The United States space station Skylab is launched

1974: Repeated failures of the N-1 rocket lead to the cancellation of Soviet plans for manned Moon landings

1981: First operational flight of a United States Space Shuttle

1986: Russian space station Mir is launched

2000: International Space Station becomes operational

2011: Last Space Shuttle flight

2012: The Voyager I probe reaches interstellar space

2018: The Voyager 2 probe reaches interstellar space

2019: Chinese robotic space probe Chang'e-4 makes first ever landing on the far side of the Moon

BALLOON CRAZY

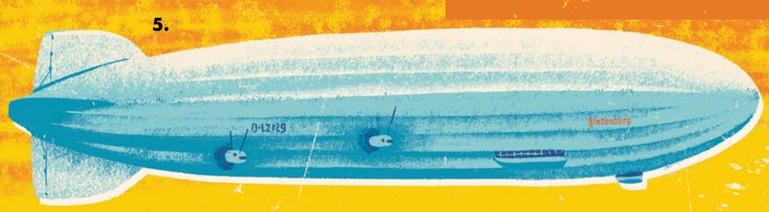
After the Montgolfier brothers conquered the air, people went balloon crazy. From the late 18th century, competitive balloonists set and broke records for speed, altitude and distance. In 1900, a new type of aircraft was also designed: the Zeppelin. These enormous airships were filled with lighter-than-air gases, either highly inflammable hydrogen or the much safer, non-inflammable helium.

1. 1783 The first manned, untethered flight was made by inventor **Pilâtre de Rozier** and the **Marquis d'Arlandes**, who travelled 8 kilometres in a Montgolfier balloon.

2. 1784 Nineteen-year-old **Elisabeth Thible**, an opera singer, became the first woman to take a trip in an untethered balloon, fetchingly dressed as the Roman goddess, Minerva.

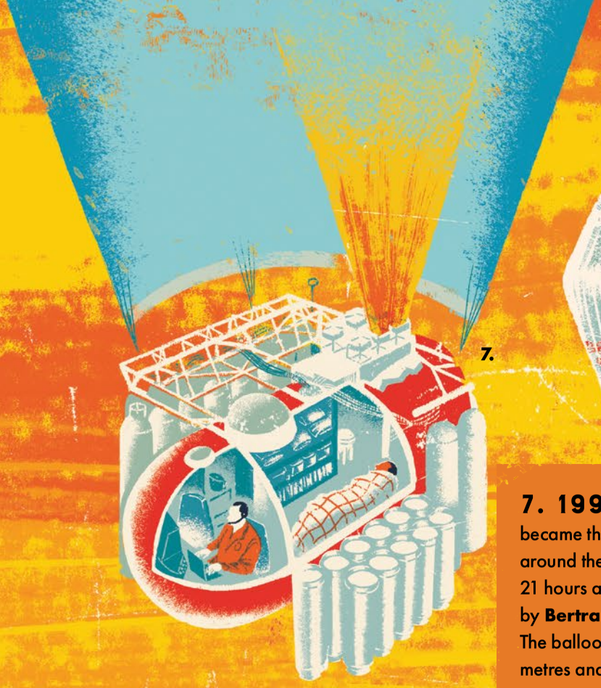
3. 1785 The first crossing of the English Channel by air was made by Frenchman **Jean-Pierre Blanchard** and American **John Jeffries**. The two had to throw almost everything – including Blanchard's trousers – out of their balloon to stay airborne long enough to cross the channel.

4. 1798 The first woman to fly solo was **Jeanne-Geneviéve Labrosse**. Her husband's niece, **Élisa Garnerin**, was the first woman to parachute, a year later.



5. 1852–1937 Airships were huge bags of lighter-than-air gas, powered by an engine and propeller. Giffard's 1852 steam-powered airship (page 15) was followed by an electrically powered one in 1883, and in 1888 by the first with an internal combustion engine. By the 1920s airships were carrying passengers. On 6 May, 1937, the **Hindenburg**, a huge 244 metre long airship of a type known as a Zeppelin, burst into flames and crashed in New Jersey in the United States, killing 35 people. The world lost confidence in airships, but by then the age of the aeroplane had already begun.

6. 1862 Aeronauts **Henry Coxwell** and **James Glaisher** took off from Wolverhampton, England, intending to study the Earth's upper atmosphere. They estimated that they climbed to 11,000 metres. They suffered frostbite and oxygen deprivation, but landed safely.



7. 1999 The *Breitling Orbiter 3* became the first balloon to fly non-stop around the world, taking 19 days, 21 hours and 55 minutes. It was piloted by **Bertrand Piccard** and **Brian Jones**. The balloon reached an altitude of 11,000 metres and a speed of almost 300 kmh.

8. 2005 **Vijaypat Singhania** piloted his hot air balloon *Envelope* to a world-record 21,290 metres in 2005, taking off from Mumbai, India, and landing safely almost five hours later.

After joining forces to fight and defeat the Nazis in the Second World War, the world 'superpowers', the United States and the Soviet Union, grew deeply suspicious of each other.

An arms race developed as each side tried to come up with the most powerful weapons, including nuclear bombs and missiles. This period of hostility is known as the Cold War because, despite the development of weapons, the two sides never actually fought each other. Space Missions became another high-profile way for the rivals to show how powerful their technology had become.

Wernher von Braun (page 27), the leading scientist in the development of the V-2 rocket, and his team surrendered to the United States at the end of the Second World War. In 1959 they were joined in the United States by **Hermann Oberth** – von Braun's former mentor – and together they made huge contributions to the development of rockets.

On the Soviet side **Sergei Korolev**, 'The Chief Designer' (page 29), developed technology that initially helped the Soviet Union take the lead in what became known as the 'Space Race'.

The Space Race really began when both sides announced in 1955 that they intended to put satellites into orbit, and it ended in 1975 when the United States Apollo, and Soviet Soyuz crafts rendezvoused in space. Between those dates, both sides achieved many milestones in space exploration – and both had plans to land on the Moon . . .

THE SPACE RACE

After the successful launch of Sputnik 1, space flights came thick and fast, with records set and broken by both the United States and Soviet Union, as missions became longer and more complex.

After the Apollo missions, the rivalry between the United States and the Soviet Union in space continued, with both countries launching space stations: the Soviet Salyut and United States Skylab. Relations between the countries improved during the early 1970s however, and on 17 July, 1975, an Apollo spacecraft docked with a Soyuz spacecraft and the two crews shook hands, beginning a new era of international co-operation in space.

SOVIET UNION

4 October: The first successful artificial satellite launch of Sputnik 1.
3 November: Sputnik 2 is launched carrying Laika the dog.

2 January: Luna 1 is the first craft launched to the Moon. It is the first man-made object to escape Earth's gravitational field.
12 September: Luna 2 becomes the first craft on the Moon after crash landing.
7 October: Luna 3 sends back the first pictures of the far side of the Moon.

April 12: Yuri Gagarin in Vostok 1 becomes the first human in space and the first to orbit Earth.

11 August: First simultaneous flight of two craft in space as Vostok 3 and 4 are both in Earth orbit at the same time.

June 16: Valentina Tereshkova becomes the first woman in space.

12 October: The first multiperson crew is launched with Vladimir Komarov, Konstantin Feoktistov and Boris Yegorov on Voskhod 1.

14 January: Sergei Korolev, 'Chief Designer' dies. His death changes the focus of the Soviet space programme. The N-1 rocket's design is never finalised.
31 January: Luna 9 makes the first controlled Moon landing and sends pictures to Earth.
31 March: Luna 10 becomes the first spacecraft to orbit the Moon.

18 March: Alexei Leonov makes the first spacewalk from Voskhod 2.

23 April: Vladimir Komarov is the first cosmonaut to die on a space mission. This was due to faults in his craft, Soyuz 1.

15 September: Zond 5 becomes the first unmanned craft to orbit the Moon and return to Earth.

16 January: Soyuz 4 and 5 complete the first transfer of crew between spacecraft.
21 February, 3 July: Two N-1 rockets, meant to take the Soviet Union to the Moon, are destroyed in failed launches.

Two further N-1 failures lead to the cancellation of the Soviet Union Moon-landing project.

UNITED STATES

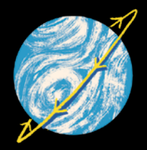
6 December: Failed launch of the Vanguard Test Vehicle 3 (TV3) satellite.

31 January: First United States satellite, Explorer 1, is launched.

7 August: First photograph of Earth from space is sent back by Explorer 6.

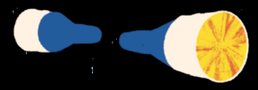
5 May: Alan Shepard in Mercury spacecraft *Freedom 7* is the first American in space. President Kennedy vows to send men to the Moon by the end of the decade.

20 February: First American to orbit Earth is John Glenn in Mercury.



31 July: First close ups of Moon sent back by unmanned Ranger 7.

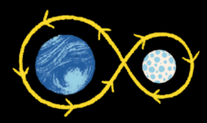
23 March: Gemini 3 takes two astronauts into space. The Gemini missions will help prepare astronauts and spacecraft for manned Moon landings.
3 June: The first American to spacewalk is Ed White from Gemini 4.
15 December: Gemini 6 and 7 make the first planned meeting of vehicles in space.



March 16: Gemini 8 is the first vehicle to dock (connect to another vehicle) in space.
May 30: Surveyor 1 is the first American spaceship to land on the Moon.

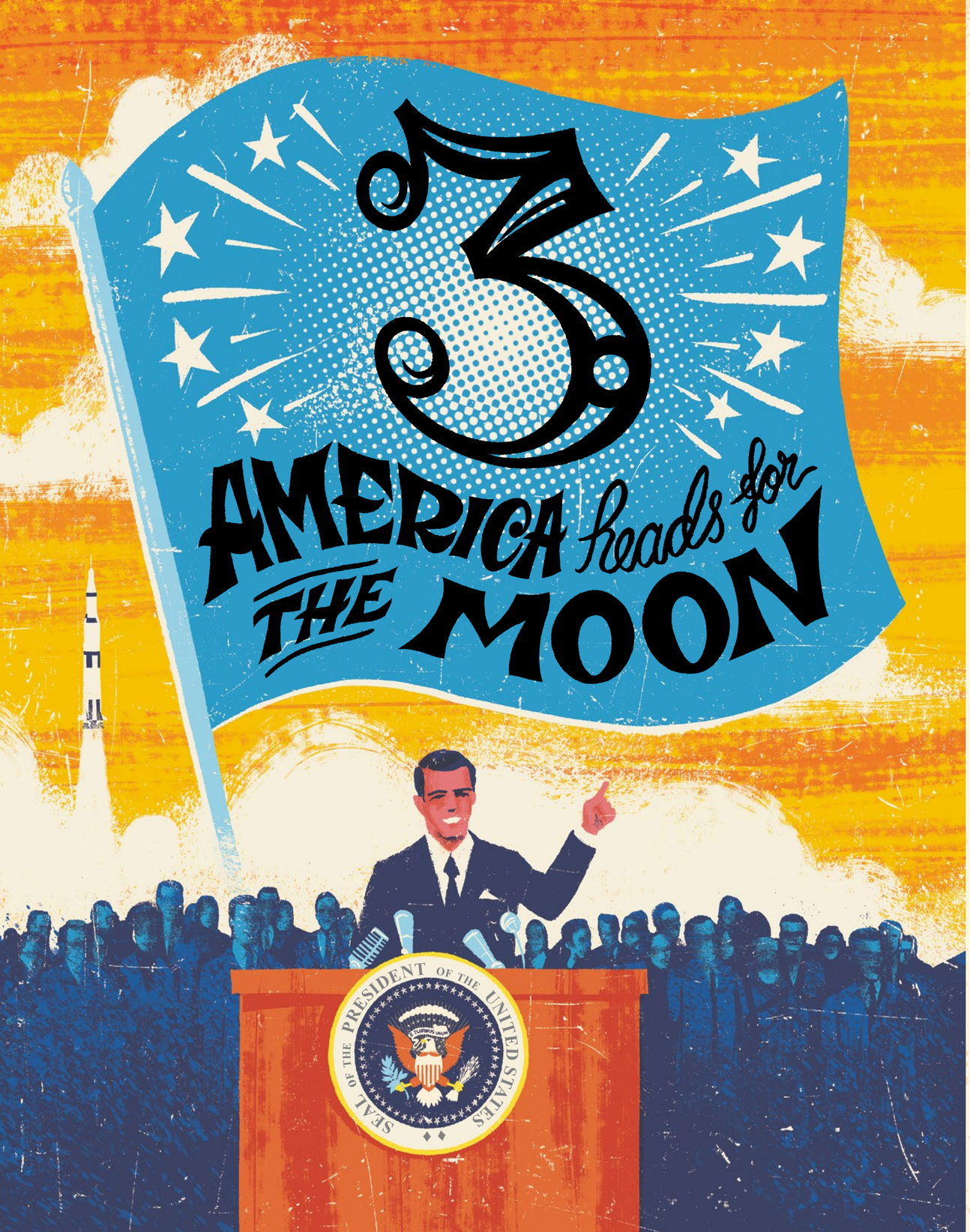
27 January: The first Apollo mission. Gus Grissom, Ed White and Roger Chaffee are killed in a fire during a preflight test.

October 11: Apollo 7, the first manned Apollo mission, orbits Earth for 11 days.
December 21: The Apollo 8 mission makes astronauts Frank Borman, James Lovell and William Anders the first humans to orbit the Moon.



20 July: Apollo 11. The first humans – Neil Armstrong and Buzz Aldrin – land on the Moon and return to Earth safely.

1957 | 1958 | 1959 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1971-1972



"Why, some say, the Moon? Why choose this as our goal? And they may well ask, why climb the highest mountain? . . . We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard . . ."

In September 1962, United States President John F Kennedy made a speech to persuade people that the Apollo programme would be worthwhile. The Mercury missions had sent astronauts into Earth orbit and returned them safely, but the longest flight had only lasted 34 hours. If the United States was to reach the Moon, crews would have to learn how to live and work in space for days at a time.

In 1965 and 1966, the thirteen Gemini missions demonstrated that space flights lasting many days were possible. The Gemini (meaning 'twins') capsules carried two astronauts who stayed in space for up to two weeks at a time.

The success of Project Gemini paved the way for the Apollo missions, the aims of which were to land astronauts on the Moon. On 21 February, 1967, **Gus Grissom**, **Ed White** and **Roger Chaffee** climbed into the Command Module of Apollo 1 to rehearse launch procedures. They were sealed in and surrounded by highly flammable 100 percent oxygen.

After five hours, a fire broke out, and within minutes all three men were dead. After this tragedy, manned flights were suspended while new safety features were introduced.